M/045/017

DEPARTMENT OF HEALTH
DIVISION OF ENVIRONMENTAL HEALTH

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CERTIFIED MAIL
(Return Receipt Requested)

June 20, 1989

Mr. Frank Wicks, V.P., General Manager
Barrick Mercur Gold Mine
P.O. Box 838
Tooele, Utah 84074

RE: Barrick February 6, 1989 Response Regarding Clay Liner Seepage from Dump Leach No. 2: Request for a Ground Water Monitoring Plan, and Plan to Control Leachate Head.

Dear Mr. Wicks:

We have reviewed the above referenced report submitted in response to our December 16, 1988 information request. Detailed comments are attached. After review of the report we have concluded that any evaluation of the clay liner's performance is a difficult task due to the complexity of the problem and the uncertainty of multiple and interdependent factors. Your February 6, 1989 report however, has failed to show that the worst-case situation does not exist. Therefore, we can only assume that the leak in the FML is located near or at the lowest point, a fact reinforced by the detection of initial leakage in as little as 2 days after commencement of operation of the dump (Barrick, July 14, 1986 letter).

Based on information you have submitted previously, including your February 6, 1989 report, we have estimated that breakthrough time could have taken place in as little as one month, under an operating head of 68 feet. Based on this same information, a single one square foot leak could pass at least 4 gallons per month of pregnant liquor solution through the clay liner. This creates significant potential for ground water contamination when one considers the possibility of multiple leaks and the fact that the dump has been in operation for nearly 3 years. As a consequence, we feel that it is imperative to request the design and implementation of a ground water monitoring network according to the following:

Ground Water Monitoring Plan

We request that you submit a ground water monitoring plan within 60 days of receipt of this letter. This plan should include:

1. An outline for hydrogeologic or other studies to characterize the ground water quality and flow system beneath the dump. Such studies will include the construction of a viable ground water monitoring network.

2. Plans and details for monitoring well or piezometer design, construction and development.

3. Projected number, depths, and locations of monitoring wells and/or piezometers.

4. Methodology to address quality assurance issues of water level measurement and ground water sampling, preservation, and analysis.

5. An operation and maintenance plan for the network, to include sampling or monitoring frequency, reporting frequency, tracking of water levels and ground water chemistry, and periodic hydraulic conductivity testing of monitoring wells or piezometers.

6. A schedule for the submittal of a final ground water monitoring plan to the Bureau for review and approval prior to commencement of well construction.

7. An implementation schedule for completion of the ground water monitoring network.

Also, due to a similar FML failure and operational history we believe similar ground water contamination concerns may also exist at Dump Leach No. 1. Therefore, we also request that a ground water monitoimg network be designed for Dump No. 1. This may be a separate network or because it is in the same proximity it may be a combined network with Dump No. 2.

Plan to Control Leachate Head

Pregnant liquor head information provided in your February 6, 1989 submittal indicates that the operational head in Dump No. 2 is in excess of "minimal" heads required in our August 8, 1986 approval of continued operation (see Condition 6). Consequently, it is requested that Barrick submit within 30 days of receipt of this letter:

1. A plan to monitor said operational levels, and

2. A compliance schedule to achieve said levels.

Also, due to the known seepage from the clay liner, the Bureau cannot allow operation of Dump No. 2 beyond the estimated life, projected to terminate in October, 1990, without assurance of ground water protection.

Please be advised that your past design and compliance history for Dumps Nos. 1 and 2 has created significant concern over possible ground water contamination, and consequently will be a major factor in any approval for Dump No. 3. As a result, we do not believe any Construction Permit approval can be issued for Dump No. 3 without resolution of the above issues regarding Dumps Nos. 1 and 2. This however, would in no way preclude Barrick from conducting predesign hydrogeologic investigations for Dump No. 3, simultaneous with the work requested above for Dumps Nos. 1 and 2.

We look forward to working with you to address these issues, however due to the nature of the risks involved we anticipate your cooperation and response in a complete and timely manner. If you have any questions please call Charlie Dietz or Loren Morton at 538-6146.

Sincerely,

Utah Water Pollution Control Committee

Don A. Ostler, P.E.
Executive Secretary

attachment

LBM:kc

cc: Charlie Dietz, BWPC
Fred Nelson, Asst. Attn. General's Office
Glen Eurick, Barrick
Ralph Sacrison, Barrick
Scott Matheson, Parsons, Behle, & Latimer
Matt Trujillo, Tooele County Health Dept.
Wayne Hedberg, DOGM

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Attachment

BUREAU OF WATER POLLUTION CONTROL

June 20, 1989

Comments on Barrick Mercur, February 3, 1989 Memo by R.R. Sacrison to G.M. Eurick, Regarding Hydrologic Performance of Dump Leach 2 Composite Liner

1. Conclusions, p.1.

   The claim that no pressure head exists on the clay liner is an oversimplification. While it is apparent that no pressure exists over the entire clay liner, as evidenced by free gravity drainage of the leak detection pipe, this does not preclude localized points of pressurized conditions elsewhere across the clay liner. At these points, high pregnant liquor heads could rapidly drive cyanide solutions thru the clay liner.

2. Detailed Discussions, pp. 1-4.

   a) Maximum and average pool depth applied to clay liner. Results in Table 1 are oversimplified. They account for pregnant liquor heads above the flexible membrane liner (FML) and not heads on the clay liner, which would be localized by holes in the FML. These heads can only be ascertained after determination of the elevation of the leaks in the FML. The heads reported are also calculated from the elevation of each lift and do not represent any independent measurement of fluid level (oral communication, R.R. Sacrison).

   b) Maximum and average surface area of clay liner exposed to leakage [p.2(b)]. Results in Table 1 are also calculations based on the FML surface, from design information. Clay liner surface area exposed to leakage should hopefully be much less than these values.

   c) Additional information to document performance of the clay liner (pp. 2-3).

      1) Once again open channel flow conditions in the leak detection pipe do not preclude localized points of pressured flow in the leak detection system (p.2). In fact, accepted hydrologic principles predict that isolated pressurized conditions will exist on the clay liner in proximity to each leak in the FML. Such pressure is a factor of pregnant liquor head and permeability in the dump, size of the FML leak and permeability and thickness of the leak detection system. At these points, high pregnant liquor heads in the dump could easily and rapidly drive cyanide contaminants thru the clay liner.

      2) The leaks in the FML and the leak collection system do not operate in a steady state condition (p.2). This is evidenced by leak collection system flow monitoring data submitted previously to us by Barrick. It is also intuitive that such leakage is directly proportional to and varies commensurately with the pregnant liquor head in the dump.

3) Liner penetration distance is erroneously low and breakthrough time erroneously high (p. 3 and Calculations, Part I). Both, as derived by Mr. Sacrison, are based on specific discharge or Darcy velocity of the clay, which ignores the effect of porosity on flow. Because the leachate actually flows thru the pore space in the clay, and not the entire Darcian cross-sectional area, the Darcian velocity must be divided by the porosity. This is commonly referred to as the average linear velocity ($\bar{v}$), which is defined as:

$$\bar{v} = \frac{Q}{PA} = \frac{Kdh}{pdl}, \text{ where } p = \text{porosity}$$

This error in leachate velocity is inversely proportional to the porosity, and therefore could result in penetration rates in excess of 250% greater than those predicted in Sacrison's February 3, 1989 memo. No data has been provided by the company on the porosity of the clay liner. However, based on commonly accepted ranges of clay porosity and clay liner permeability and operational head data provided in Sacrison's February 3, 1989 memo, the penetration time of clay could be as little as one (1) month. This is alarming in that the dump has been operated for nearly three years, thus potentially resulting in a significant loss of cyanide contaminants to ground water.

4) Cyanide attenuation by the clay liner, including carbon adsorption, has not yet been quantified, and we are awaiting the results of such testing (p.3). For any such information to be useful, the several factors must be addressed, including:

- Cyanide adsorption capacity of the clay, or mass of cyanide adsorbed per unit mass of clay liner. This capacity must be defined by its average and minimum values.
- Exhaustibility or limitations of the cyanide attenuation mechanism(s).
- Average and maximum cyanide concentration in the leachate, including total, free, and weak-acid dissociable cyanide.
- Area and volume of the clay liner exposed to the leachate.
- Flow rate of the leachate thru the clay which is a product of clay permeability, effective head on the clay, and cross-sectional area of the flow.

3. General Comments.

Our August 8, 1986 approval of continued operation of Dump 2 was in part based on a condition that Barrick maintain the pregnant liquor head in the dump at a minimal level (see Condition No. 6). Such minimal levels were assumed to be on the order of approximately 10 feet above the flexible membrane liner (FML) based on Dump 2 design, and justification and analysis provided by Barrick via an April 29, 1986 letter by Walter Jones of Northern Engineering and Testing, Inc.

Sacrison's February 3, 1989 memo indicates that the average pregnant liquor head in the dump has ranged from 12-34 feet, with a maximum possible head of 68 feet (Table 1). Subsequent conversation with Mr. Sacrison has disclosed (April 21, 1989):

1. The bottom of the pregnant liquor collection cistern is approximately 8 feet above the lowest point in the FML,

2. The data provided in Table 1 of the February 3, 1989 memo are based on the elevation of each lift; not on independent monitoring data, and

3. Current pregnant liquor head in the dump is approximately 58 feet above the FML low point.

No information has been provided on the elevation(s) of the leak(s) in the FML under Dump 2. Consequently, we can only assume that the leak(s) occur at or near the lowest point in the FML. These reported heads do not appear to be in compliance with Condition No. 6 of our August 8, 1986 approval. Operation of the dump at high pregnant liquor levels can only increase the velocity and amounts of cyanide contaminants that pass thru the clay liner and into the ground water environment. Barrick's apparent failure to locate the elevation of the leaks in the FML and to accordingly monitor and control the pregnant liquor head in Dump 2 is very disturbing.